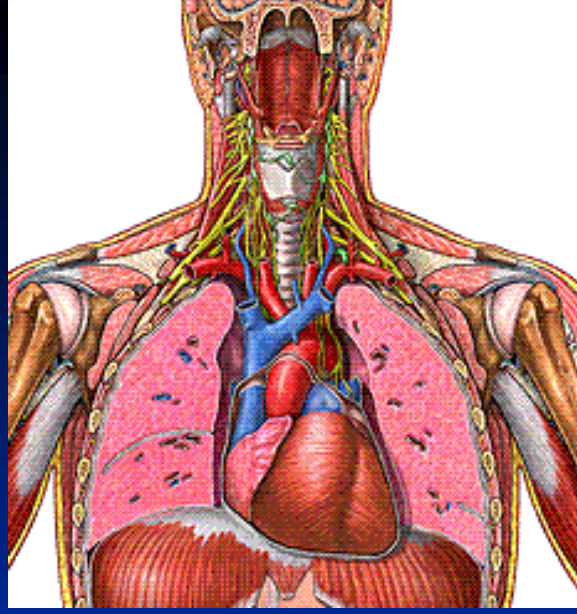
Ch 19: Cardiovascular System

- The Heart -



•Give a detailed description of the superficial and internal anatomy of the heart, including the pericardium, the myocardium, and the cardiac muscle.

•Trace the path of blood through the heart.

•Explain the functioning of the valves of the heart and how they relate to the heart sounds.

•Discuss the conductive pathway of the heart, and relate that to clinical uses of the ECG.

Developed by
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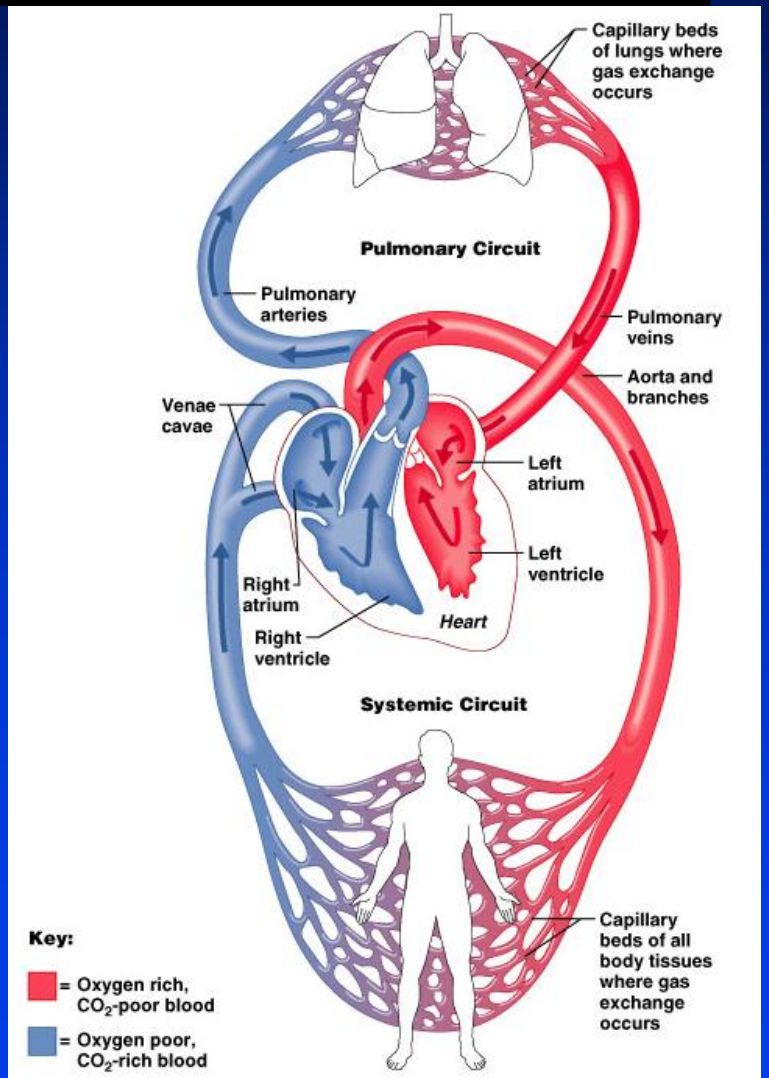
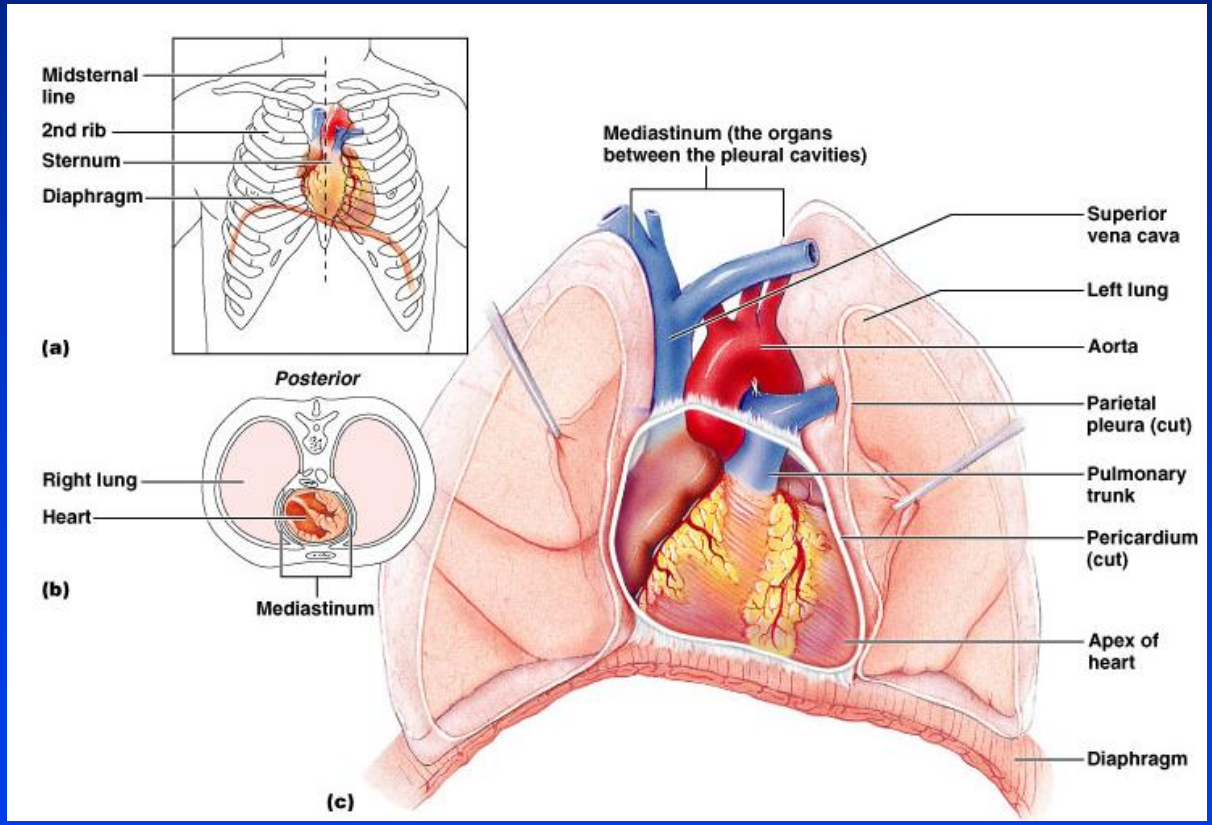
Circulation:: Overview

- Size of a Fist
  - 250 – 350 grams
- Double Pump
  - Oxygenated and deoxygenated blood
  - About 16,000 liters/day!
- Pulmonary circuit
- Systemic Circuit

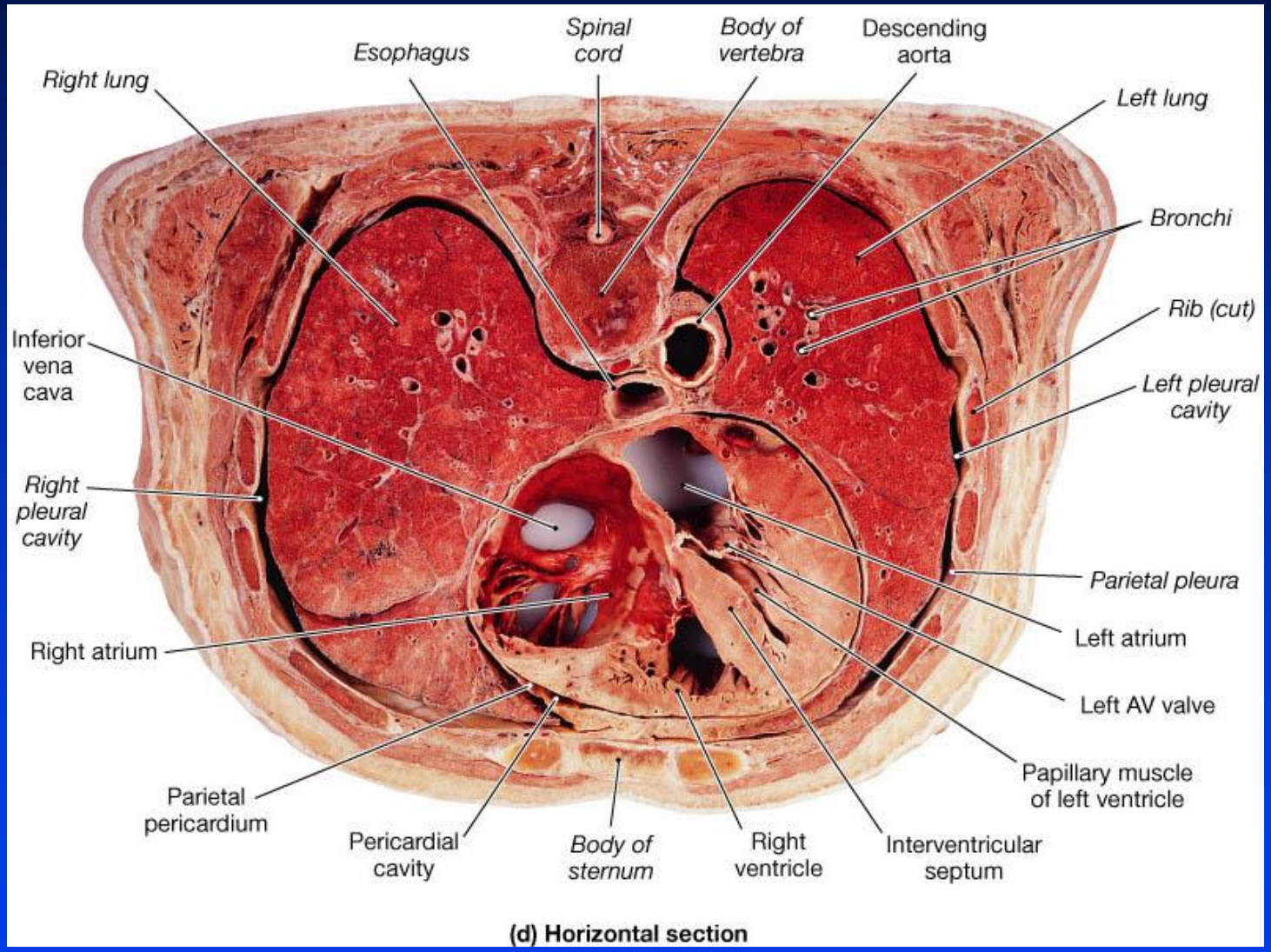


Location of the Heart

- Posterior to the Sternum
- Within the Mediastinum
- Apex vs. Base



sectional view: **position immediately posterior to sternum . . .**



Cardiac Muscle

- Striated, aerobic, interwoven, branched, autorrhythmic
- Intercalated discs - gap junctions, strong desmosomes
- Functional syncytium

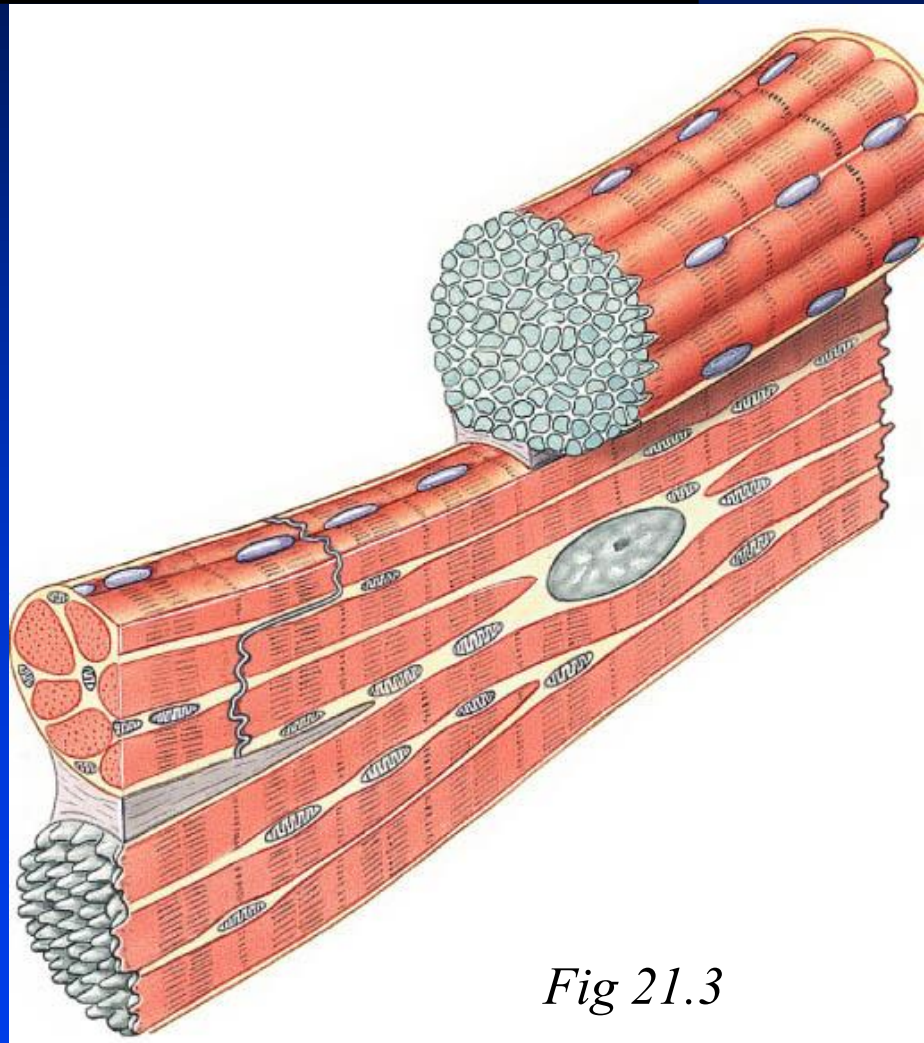
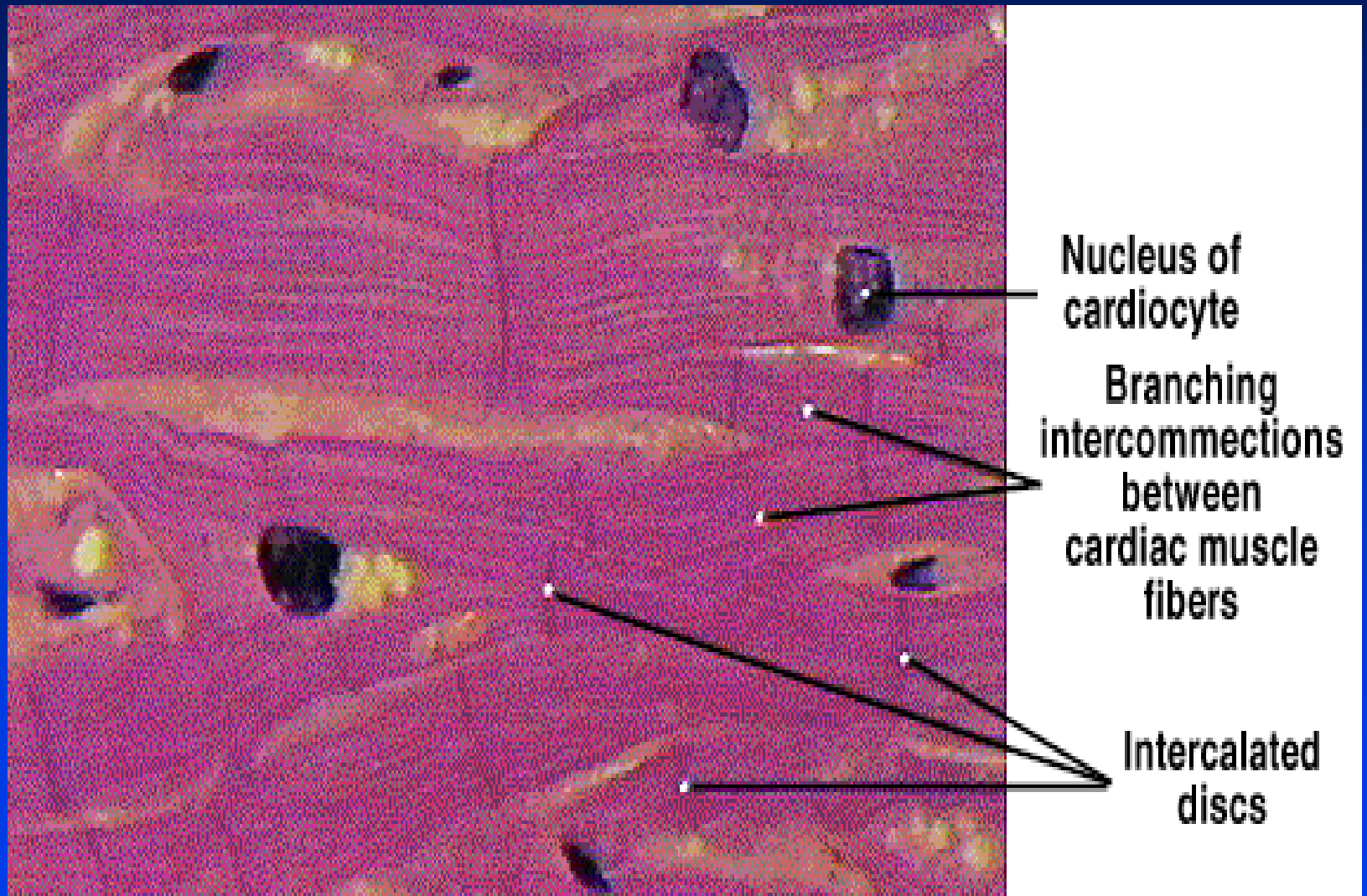


Fig 21.3

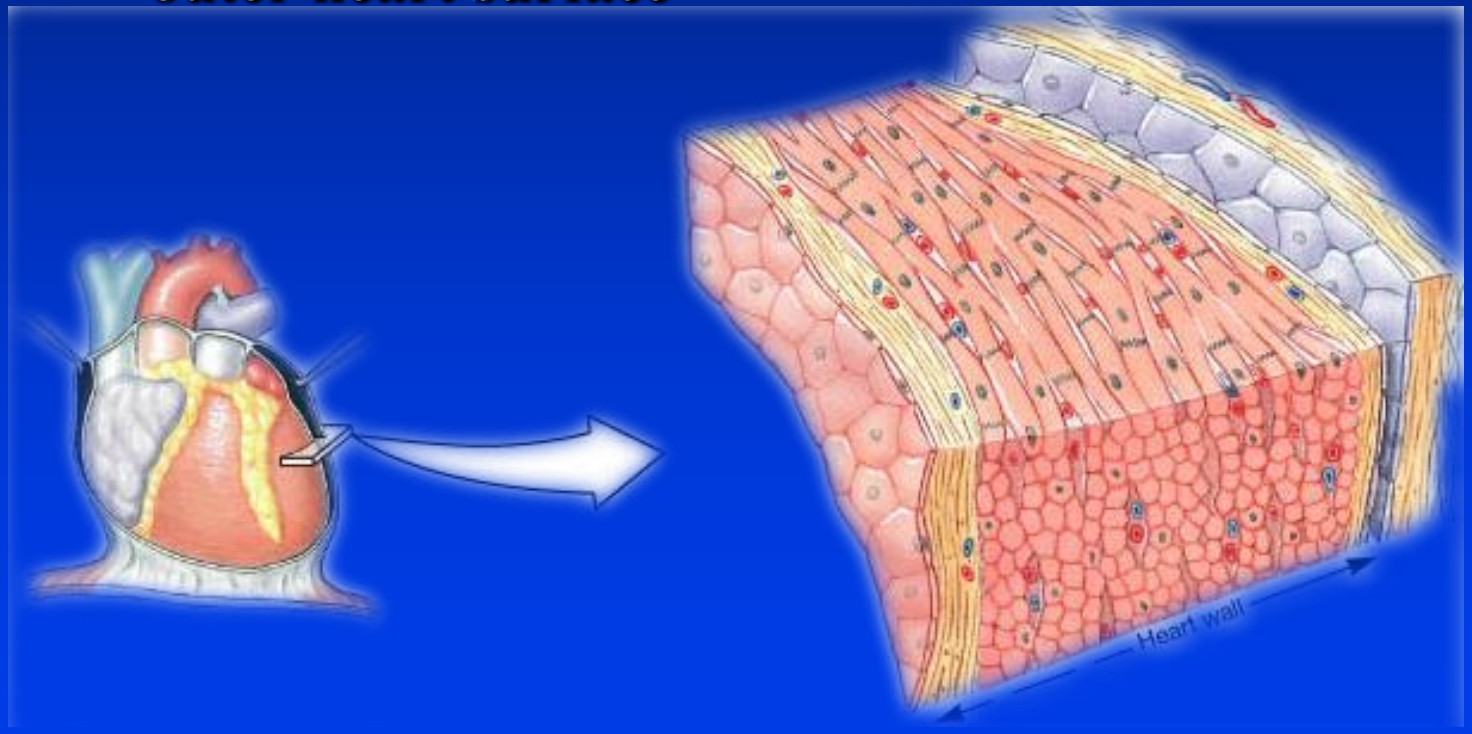
Cardiac Muscle

Different from skeletal muscle?



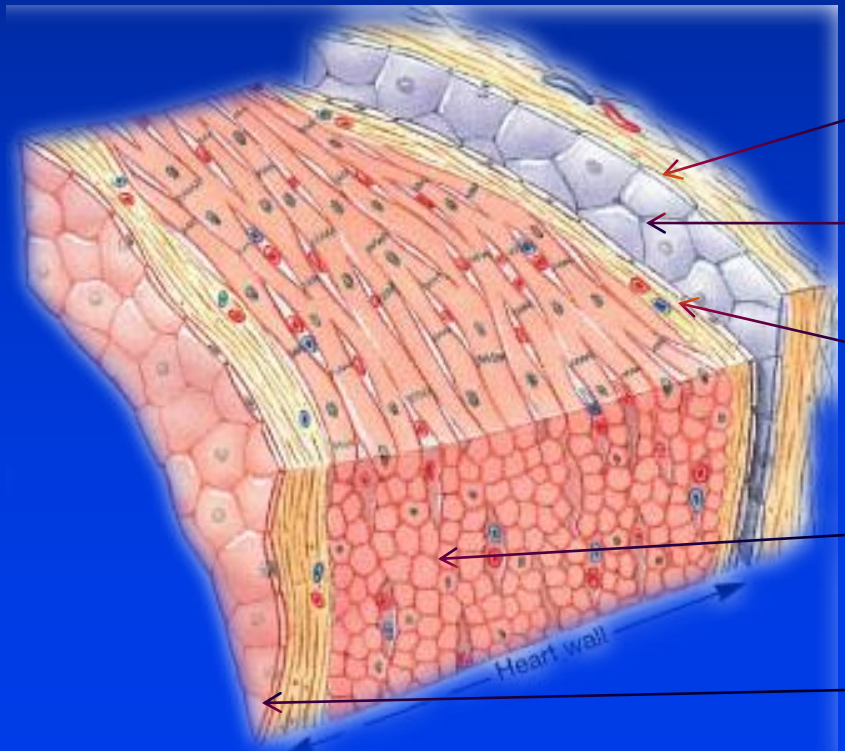
Pericardium - *Sac*

1. Fibrous pericardium (AKA heart sac)- tough, collagenous
2. Serous parietal pericardium (lines fibrous pericardium)
3. Pericardial space with 10-20 ml of pericardial fluid
4. Serous visceral pericardium (AKA epicardium) adheres to the outer heart surface



Structure of Heart Wall

- **Epicardium** = visceral Pericardium (serosa)
- **Myocardium**: muscle tissue + c.t. + blood vessels + nerves
- **Endocardium**: simple squamous epithelium continuous with endothelium of blood vessels



Pericardium

Pericardial fluid

Epicardium

Myocardium

Endocardium

Fibrous Skeleton

- **Internal c.t. network with lots of collagen and elastic fibers**

Encircles bases of great vessels

Encircles bases of valves

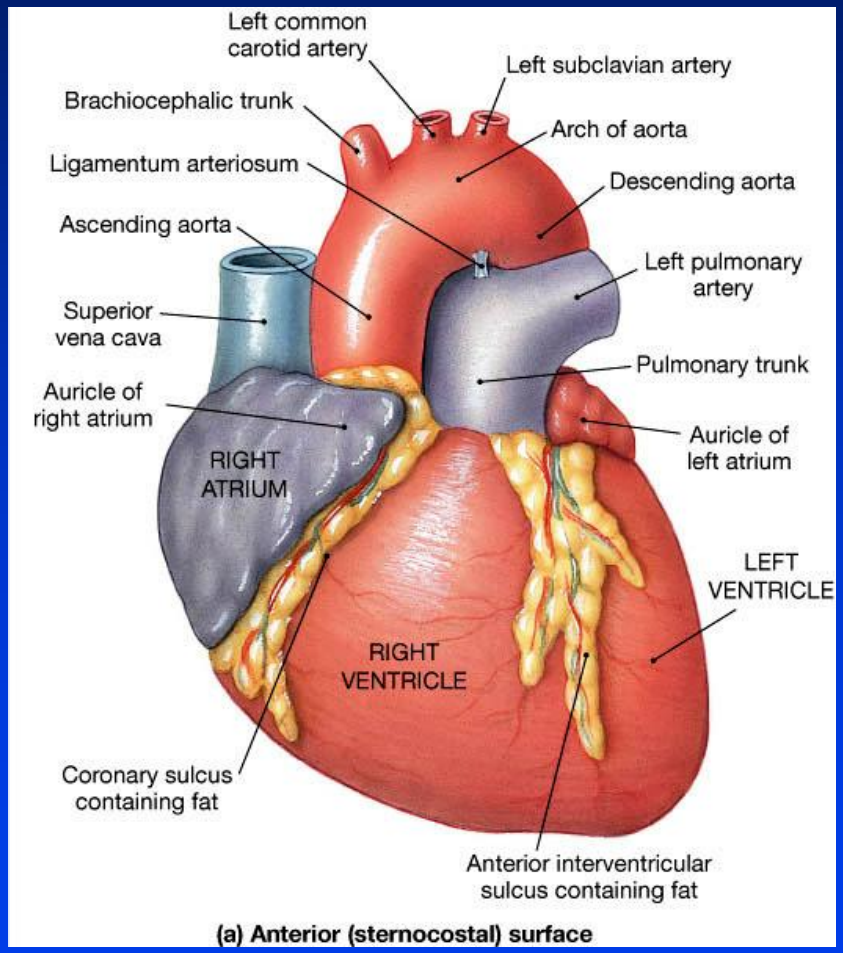
functions:

Isolate atria from ventricles electrically

Reinforce myocardium itself

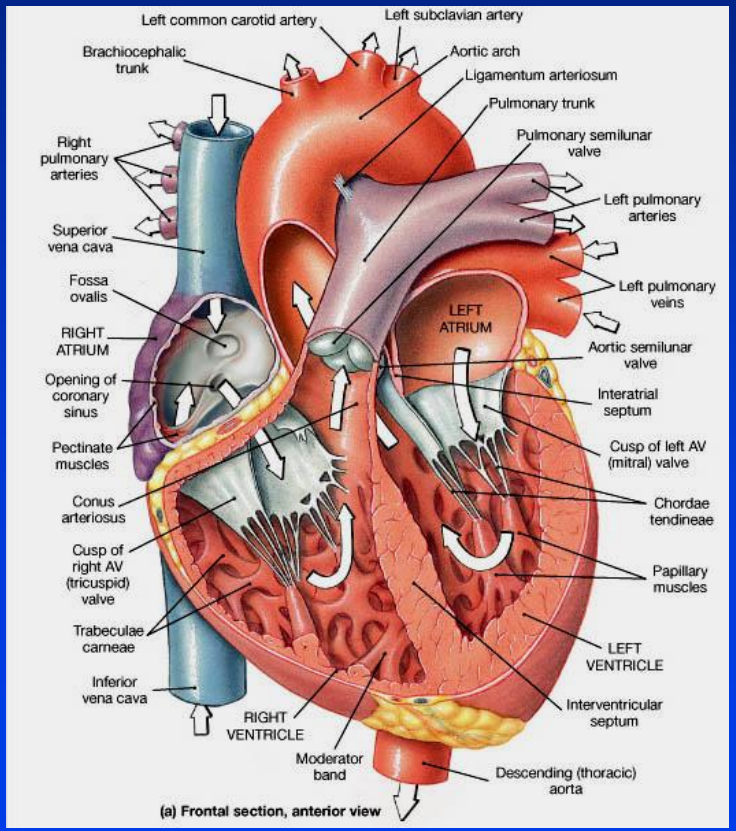
Surface Anatomy

- **Auricle** of atria (expandable)
- **Coronary sulcus** (between atria & ventricles)
- Ant. & post. **interventricular sulcus**
- **Base** (3rd costal cartilage) vs. **apex** (5th intercostal space)
- **Vessels** entering & leaving the heart



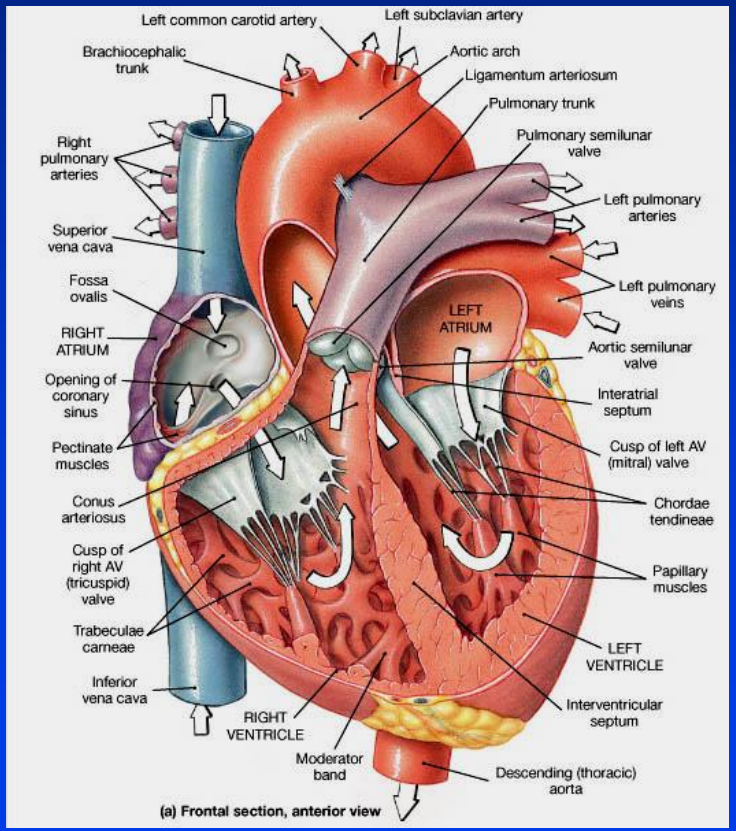
The Chambers

- Separated by
  - Interatrial Septum
  - Interventricular Septum
  - Externally, the septa appear as shallow sulci
- Right Atrium
  - Receives blood from superior and inferior venae cavae and the coronary sinus
  - Right auricle is prominent externally
  - Pectinate Muscles



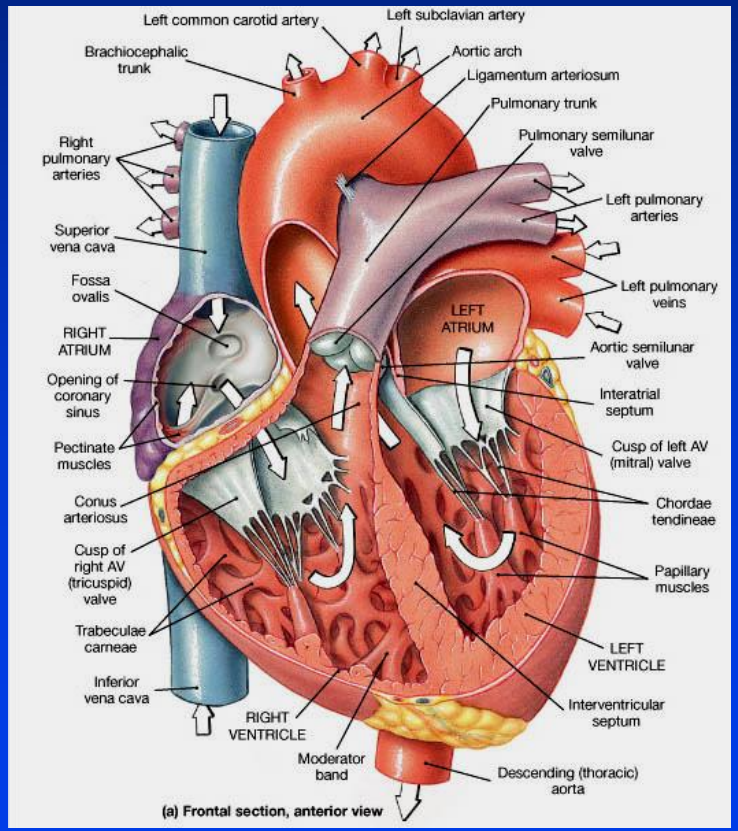
The Chambers

- Right Ventricle
  - Receives blood from the right atrium via the right AV valve, AKA tricuspid valve
    - Supported by chordae tendinae and papillary muscles
  - Thin wall
  - Network of trabeculae carneae



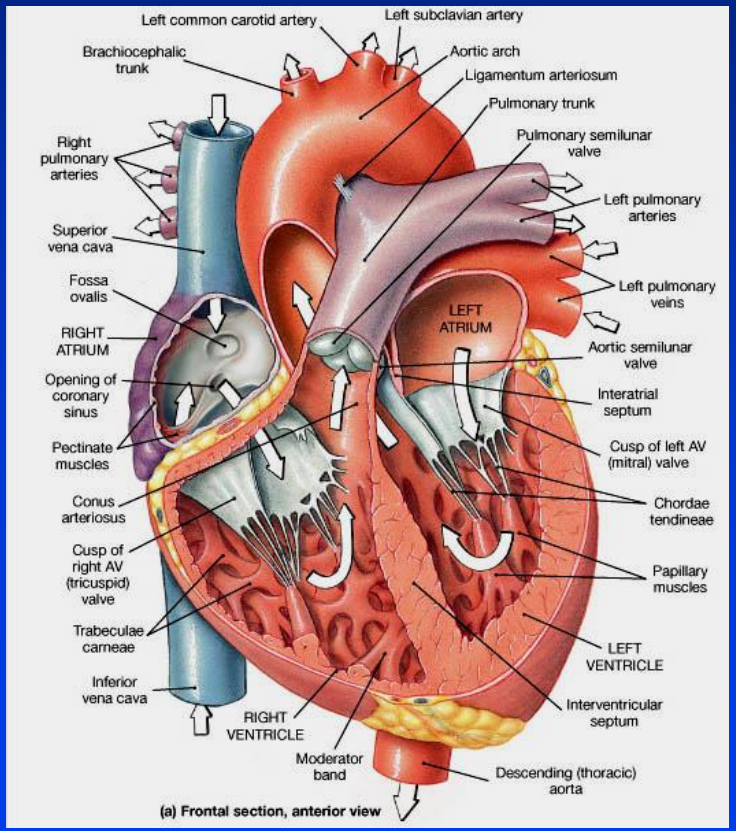
The Chambers

- Left Atrium
  - Receives blood from R and L Pulmonary Veins
- Left Ventricle
  - Receives blood from the Left AV valve (AKA mitral AKA bicuspid)
    - Chordae tendinae and papillary muscles
  - Thick wall
    - Pumps to body via Aortic Semilunar Valve



Sectional (Internal) Heart Anatomy

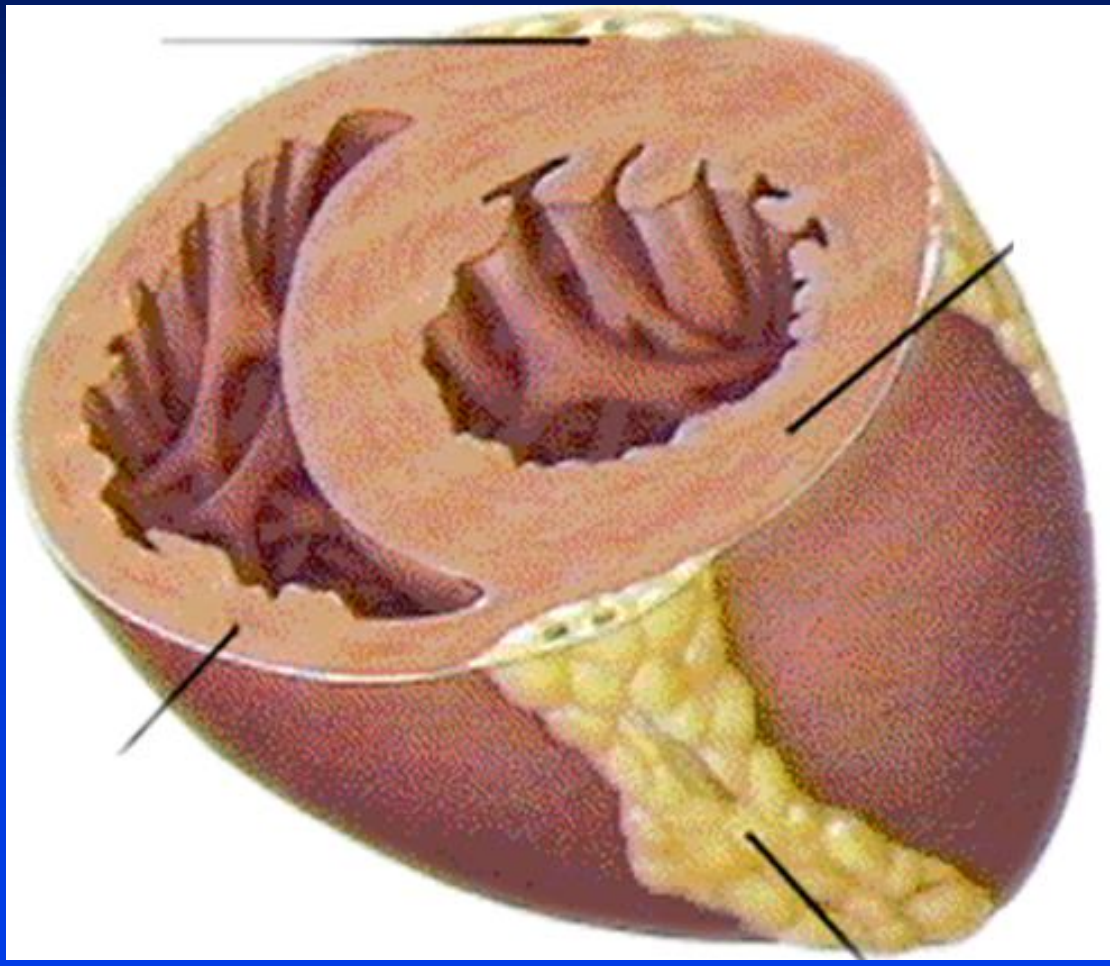
- Atria & ventricles
- Interatrial & interventricular septa 9981621
- Valves (fibrous tissue)
- Pectinate muscles (auricles & ant. atria)
- Trabeculae carneae (ventricles)
- Chordae tendinae & papillary muscles



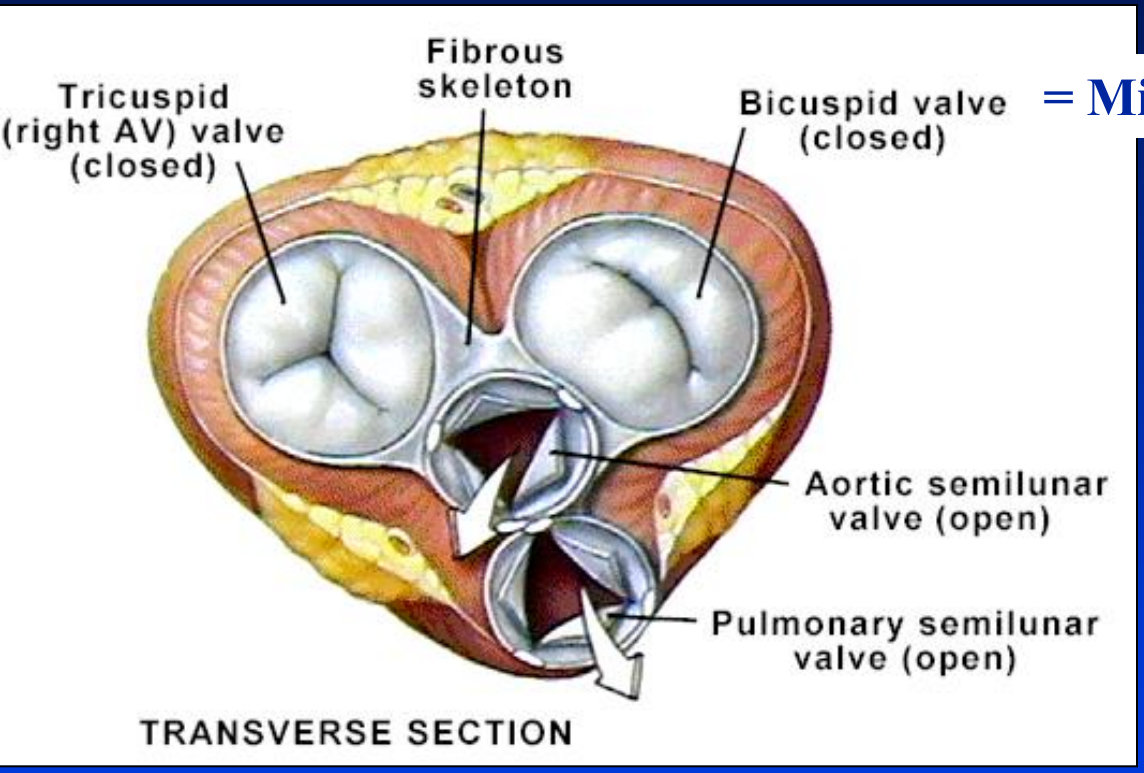
Left vs. Right Ventricle

Left: high pressure pump - Right: low pressure pump $\Rightarrow$ right chamber is thinner walled than left

Ventricles separated by interventricular septum



Structure and Function of Valves (prevent backflow)



= Mitral valve = Left AV valve

4 sets of valves

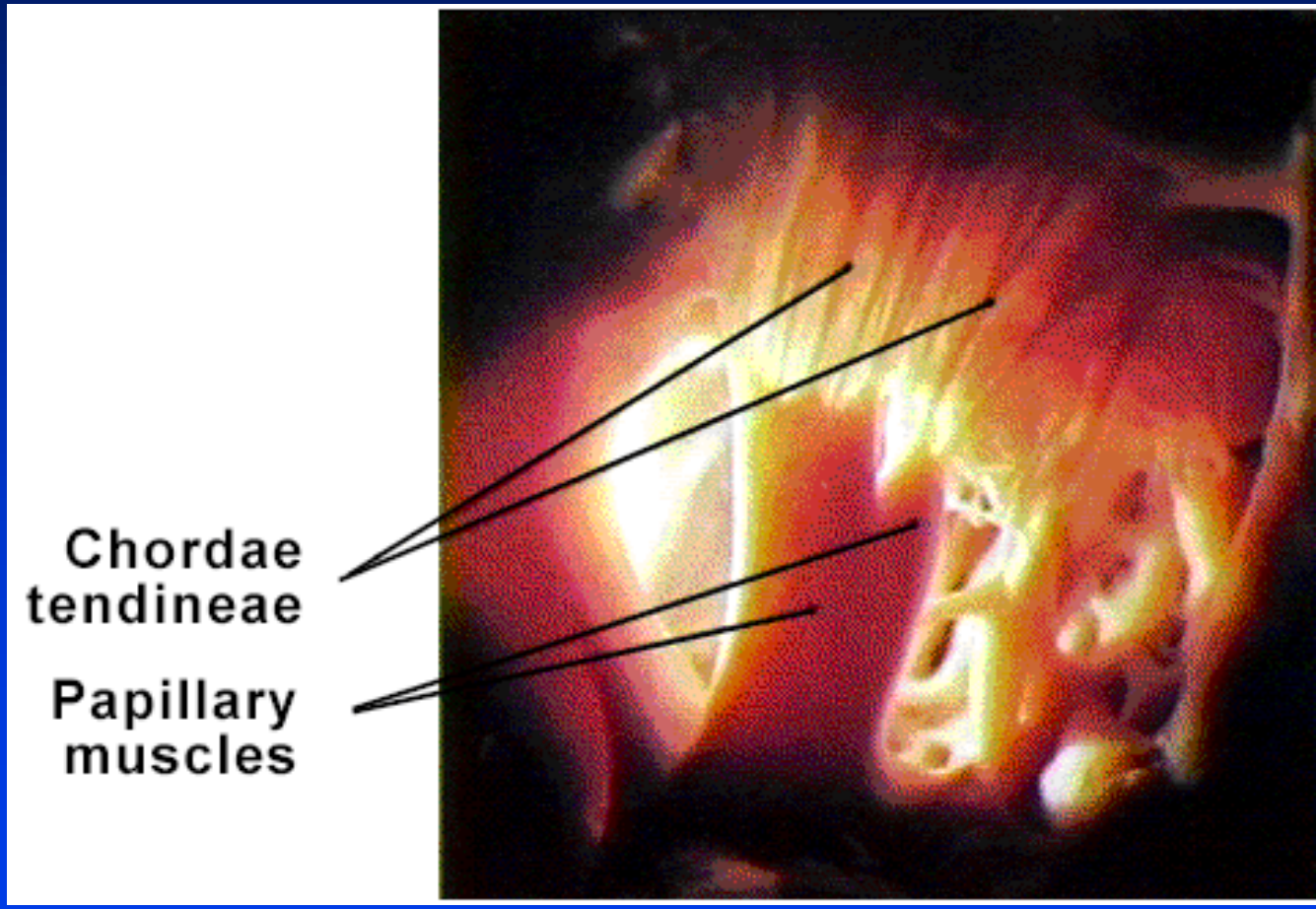
Each cusp is C.T. covered with endothelial cells

Close passively under blood pressure

Heart sounds produced by valve closure

Support for AV valves:

Valves are restrained by chordae tendinae which are in turn attached to papillary muscles (prevention of backflow!)



picture taken from R ventricle, looking toward R atrium *(see fig 21.6)*

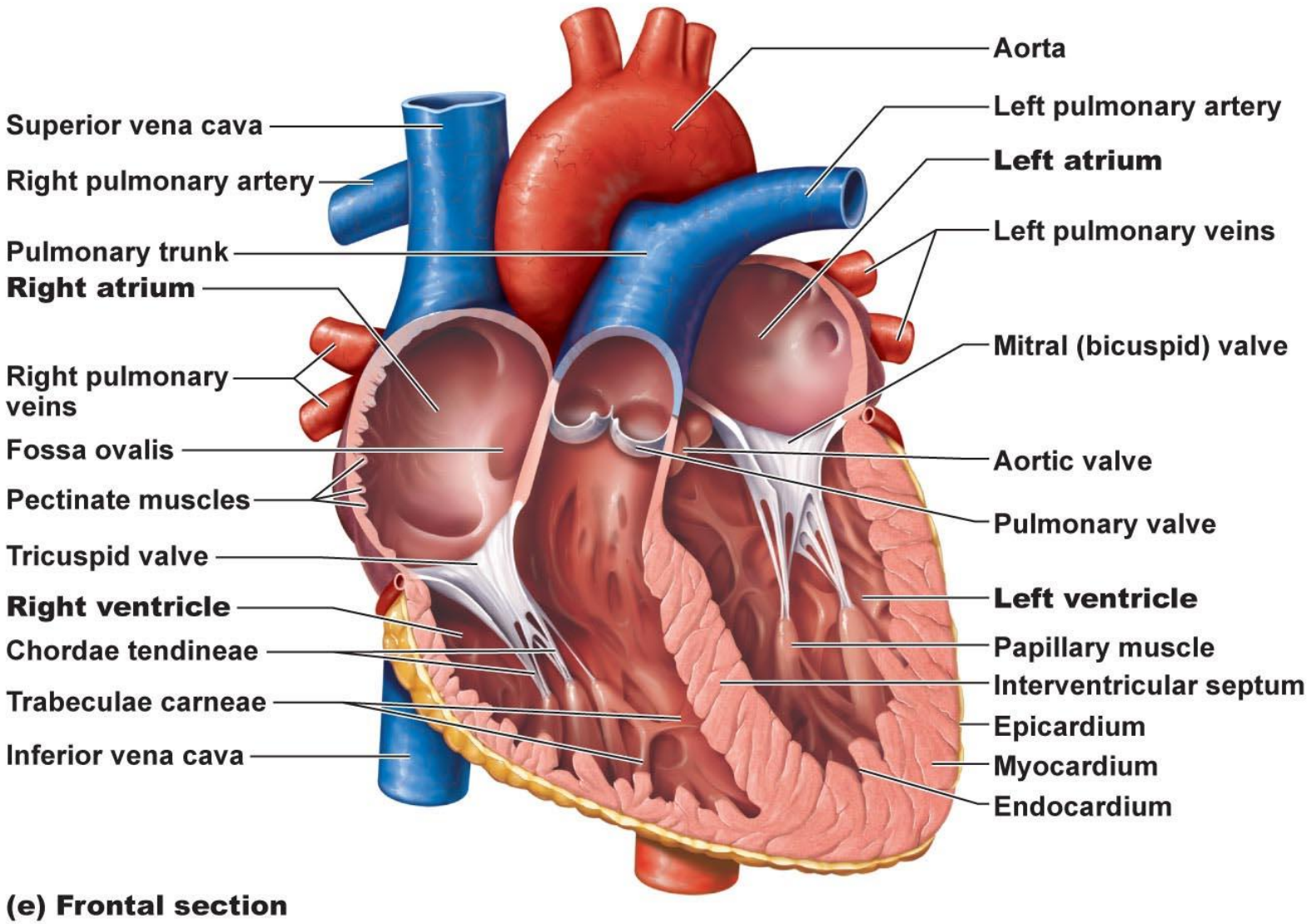


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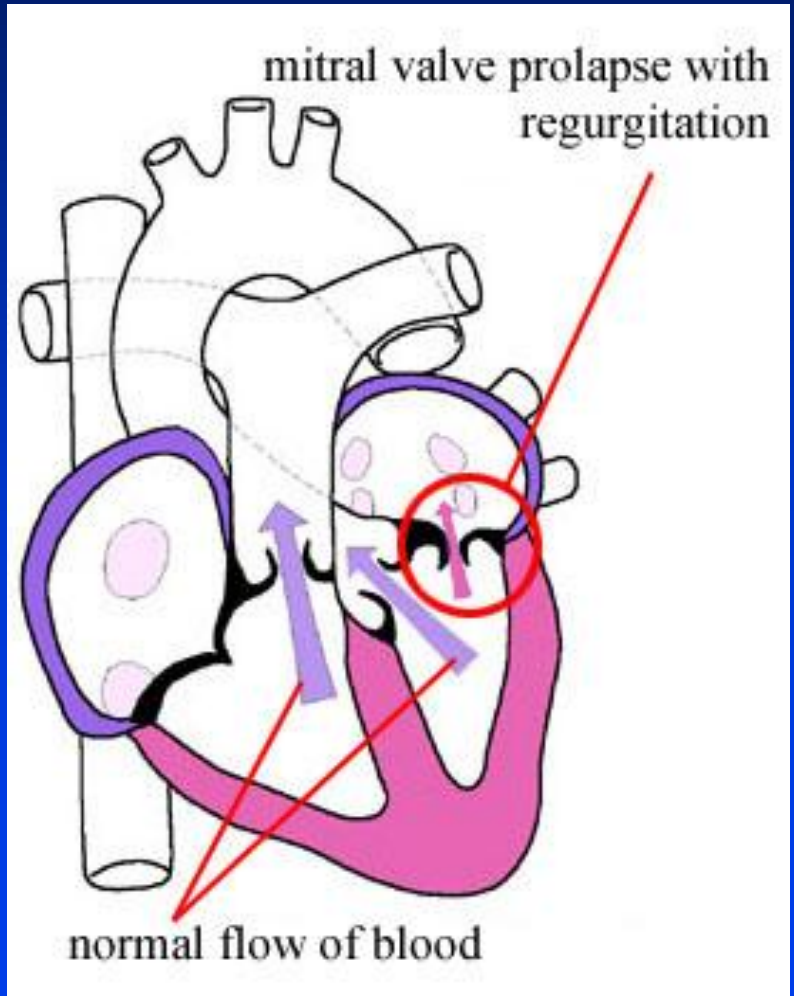
Fig 19.5 e

Mitral Valve Prolapse

- Most common cardiac variation (5-10% of population)
- Mitral valve cusps do not close properly
- Regurgitation during left ventricular systole

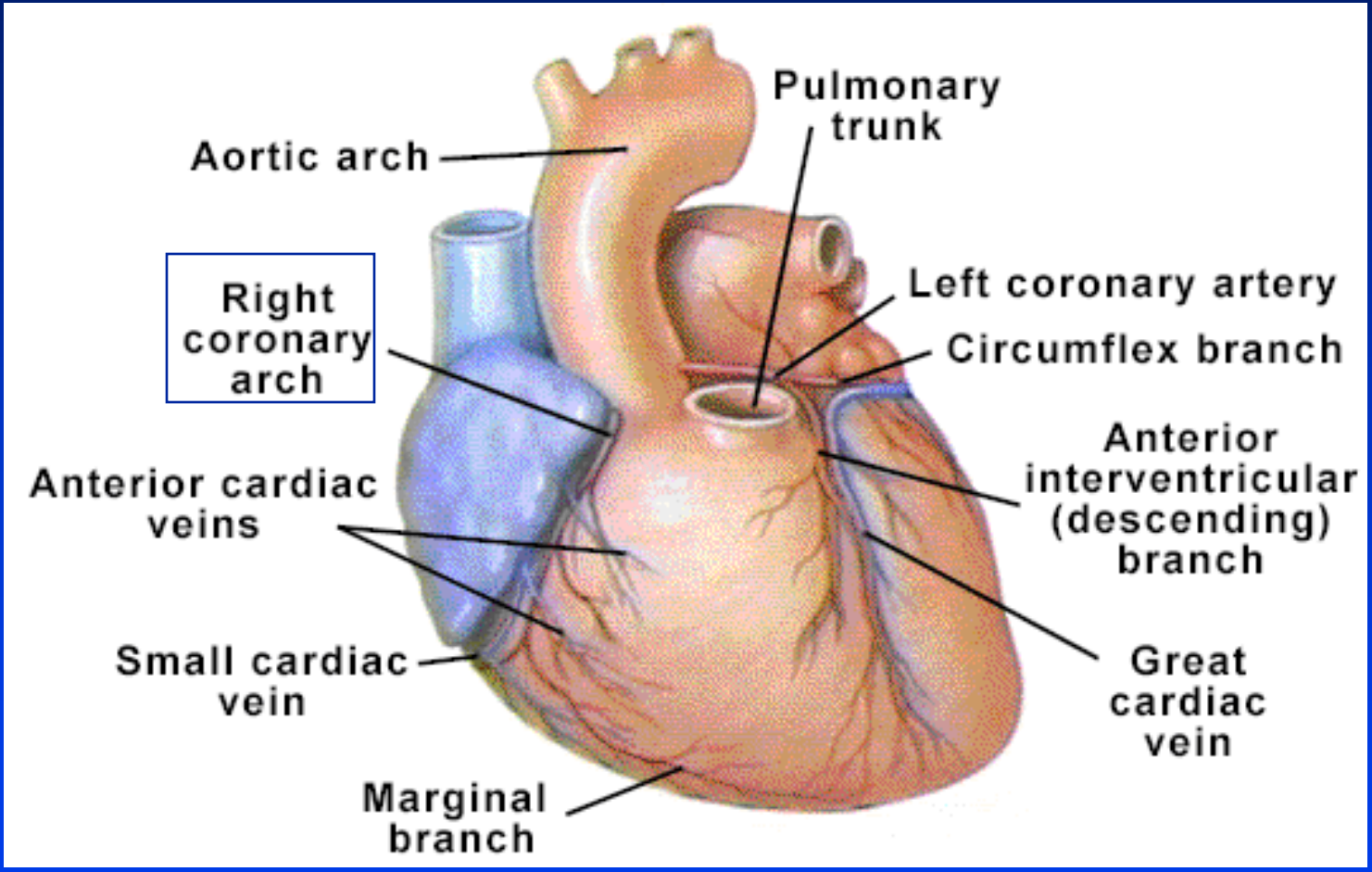
Not life threatening;
lifestyle threatening

How can you diagnose?



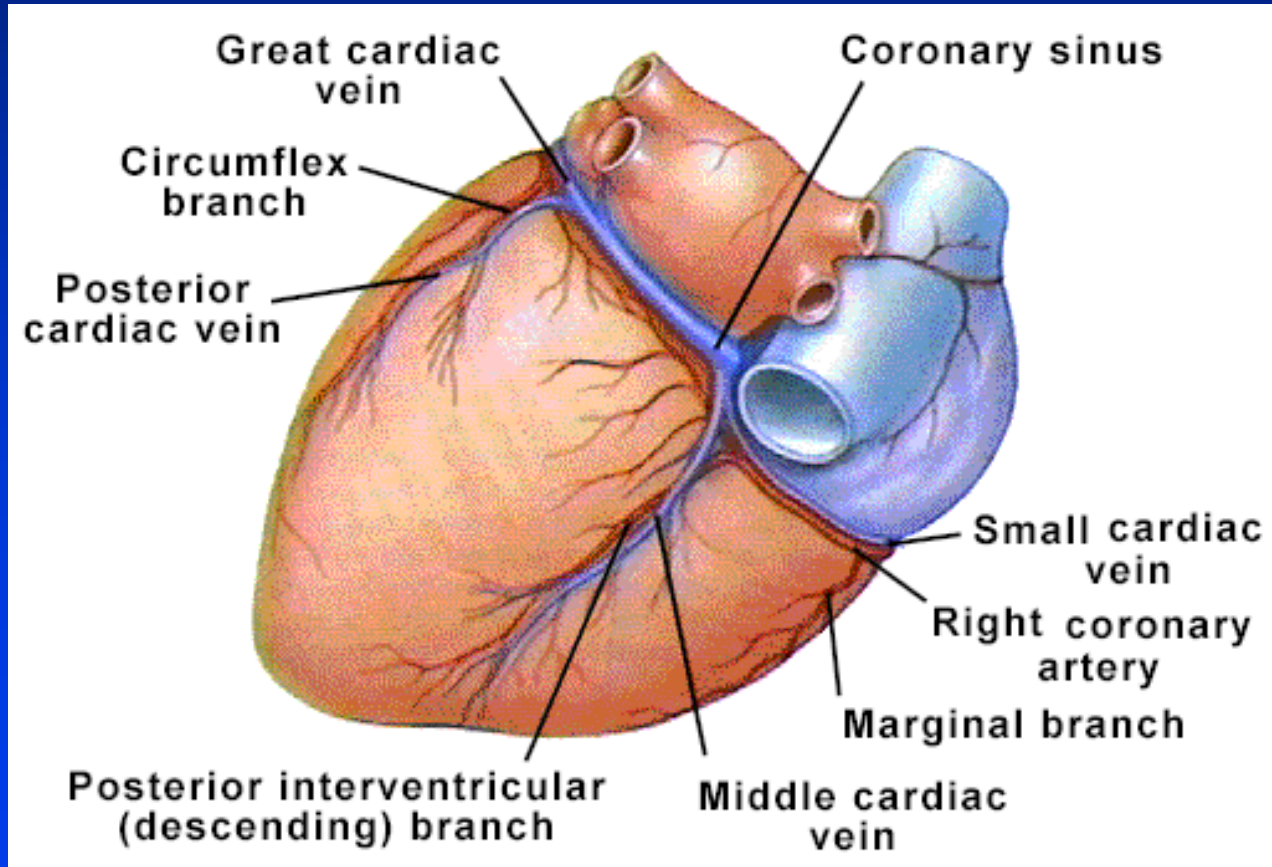
Coronary Circulation

Coronary arteries: branch off the ascending aorta, immediately distal to the aortic valve



Coronary Circulation, cont'd

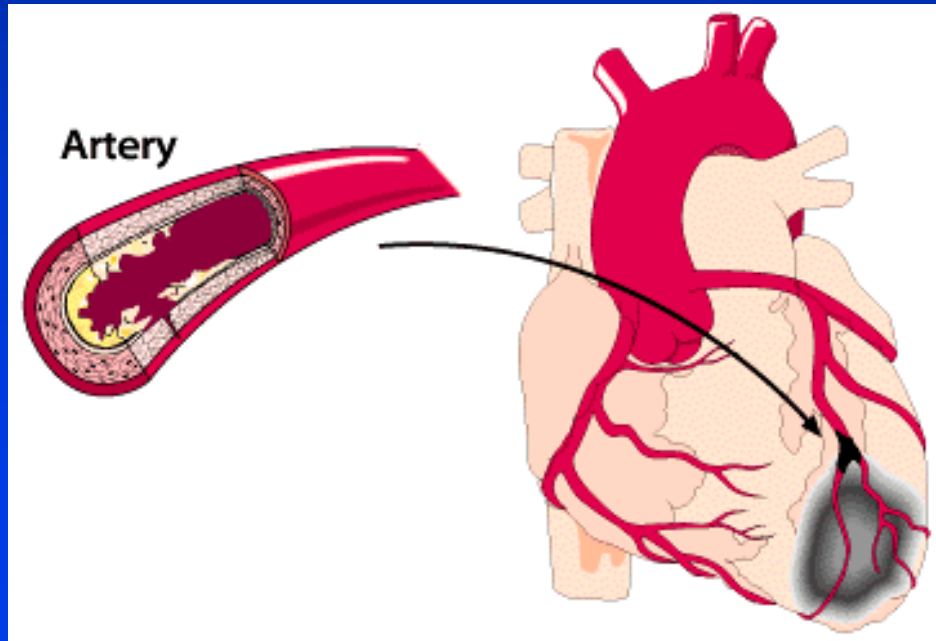
coronary veins to coronary sinus to right atrium (inferior to opening of inferior vena cava)



posterior view

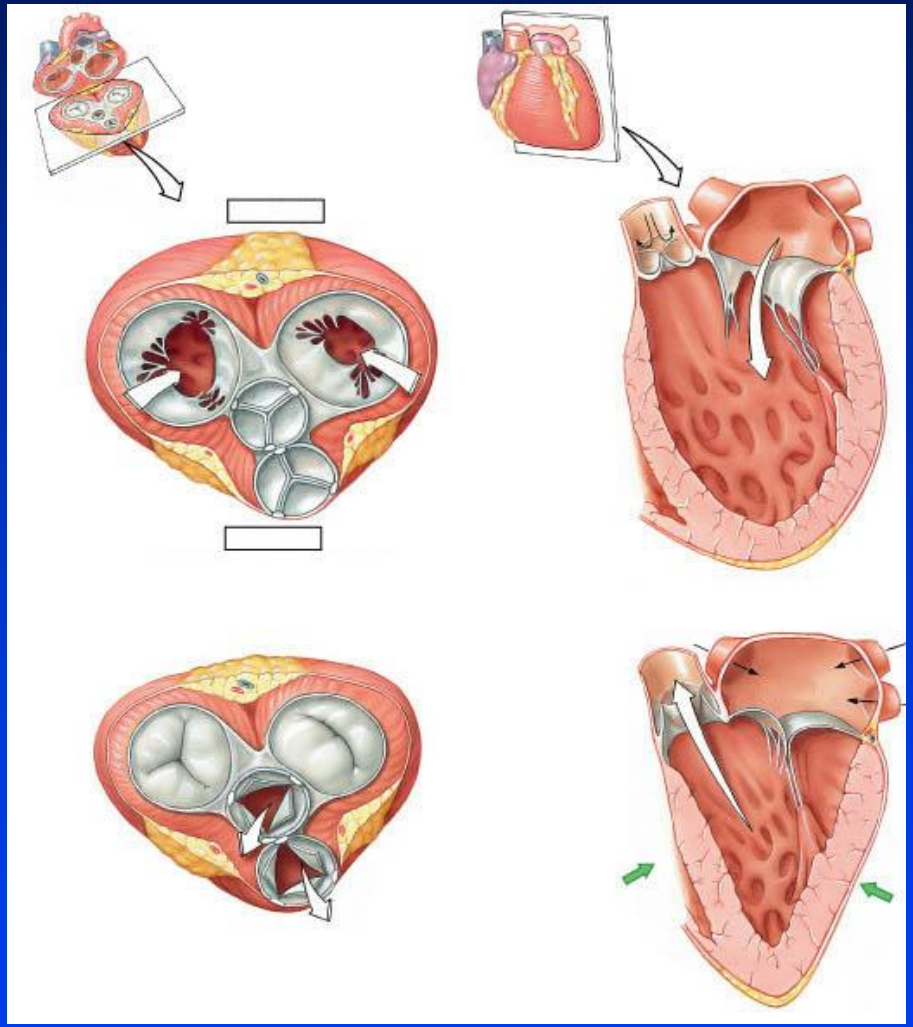
Myocardial Infarction (MI)

- ~ 1.3 x 10^6 MIs / year in US
- Most commonly due to severe CAD (coronary thrombosis)
- Ischemic tissue degenerates → nonfunctional area = infarct
- Predisposing factors?



Cardiac Cycle

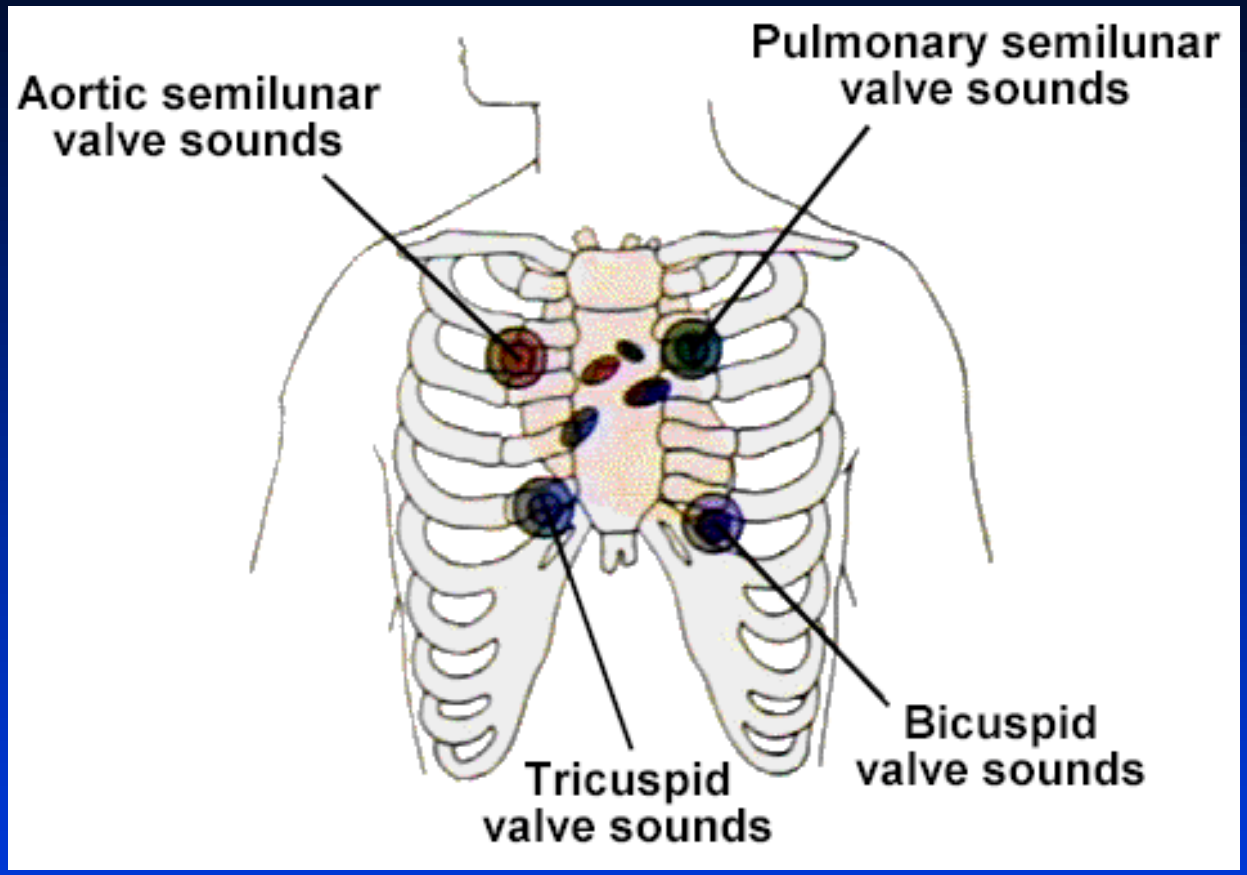
- Actual physical contraction pattern of the myocardium as determined by the conduction.
- A. Contraction is **systole**
- B. Relaxation is **diastole**
- The two atria are in systole and diastole together as are the two ventricles.



Blood flow pattern through the heart

1. Blood enters right atrium via the superior and inferior venae cavae
2. Passes tricuspid valve into right ventricle
3. Leaves by passing pulmonary semilunar valves into pulmonary trunk and to the lungs to be oxygenated
4. Returns from the lung by way of pulmonary veins into the left atrium
5. From left atrium past bicuspid valve into left ventricle
6. Leaves left ventricle past aortic semilunar valves into aorta
7. Distributed to rest of the body

Auscultation of Heart Sounds:



<u># 1 (Lub):</u> at beginning of ventricular contraction, due to closure of the AV valves

<u># 2 (Dup):</u> at beginning of ventricular diastole, due to closure of the semilunar valves

Conducting System of the Heart p 570

Specialized muscle cells in the heart conduct APs to time and synchronize the action of the chambers

- **SA node** – "pacemaker," spontaneously depolarizes most rapidly and initiate heart beat, positioned on back wall of right atrium , transmits action potential to the AV node.
- **AV node** - (where the four chambers meet). Delay here.
- **AV bundle** (bundle of His) transmits down top of interventricular septum where it divides into two.
- **Bundle branches**, one of which supplies each ventricle where they branch into
- **Purkinje fibers** reflect up external walls of ventricles and stimulate contraction of cardiac muscle cells as a unit.
- Purkinje fibers extend into papillary muscles as well

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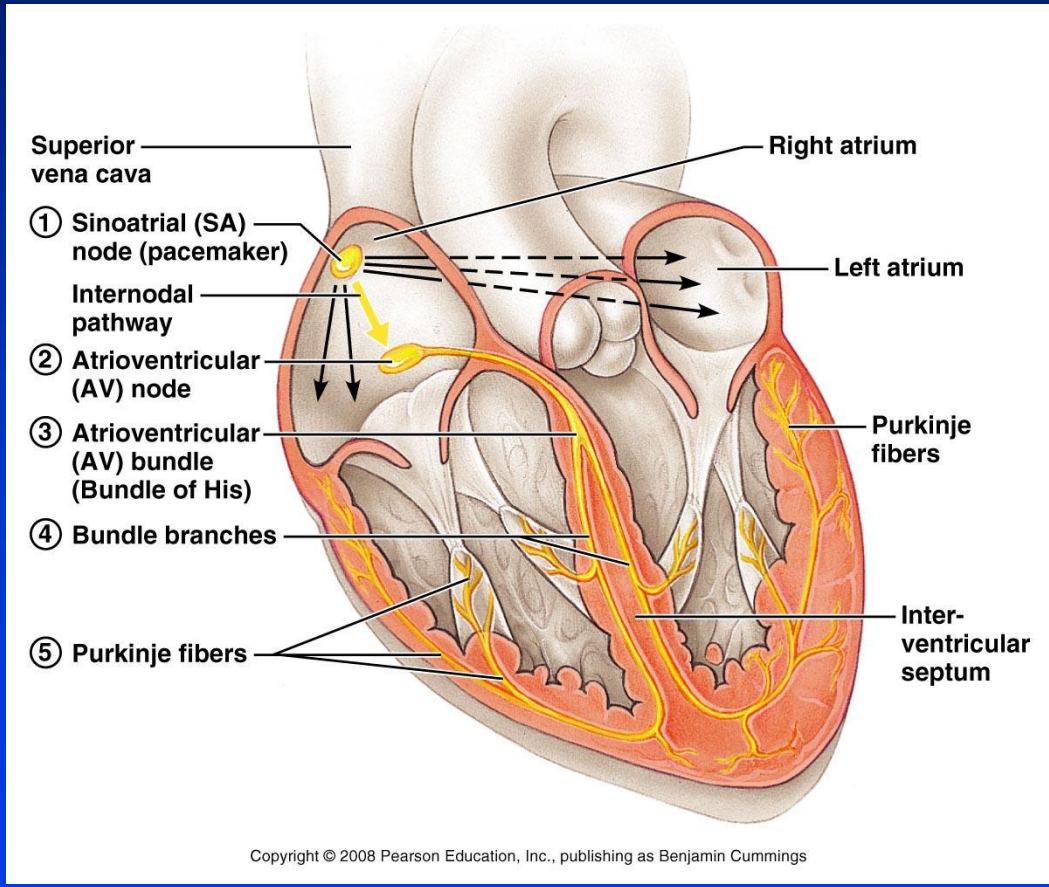

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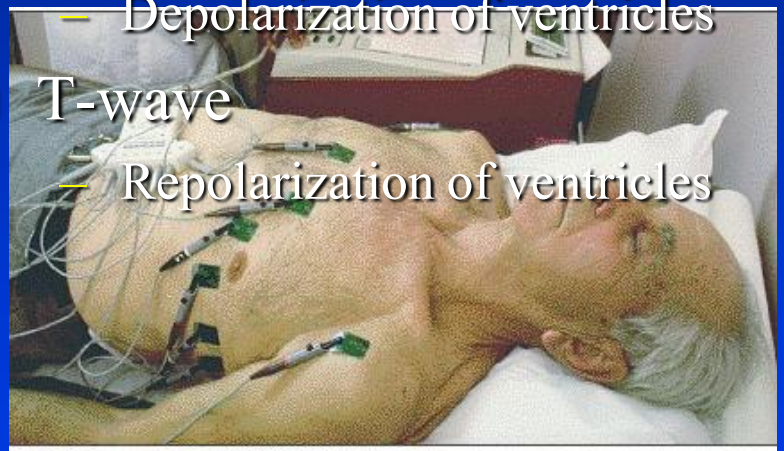
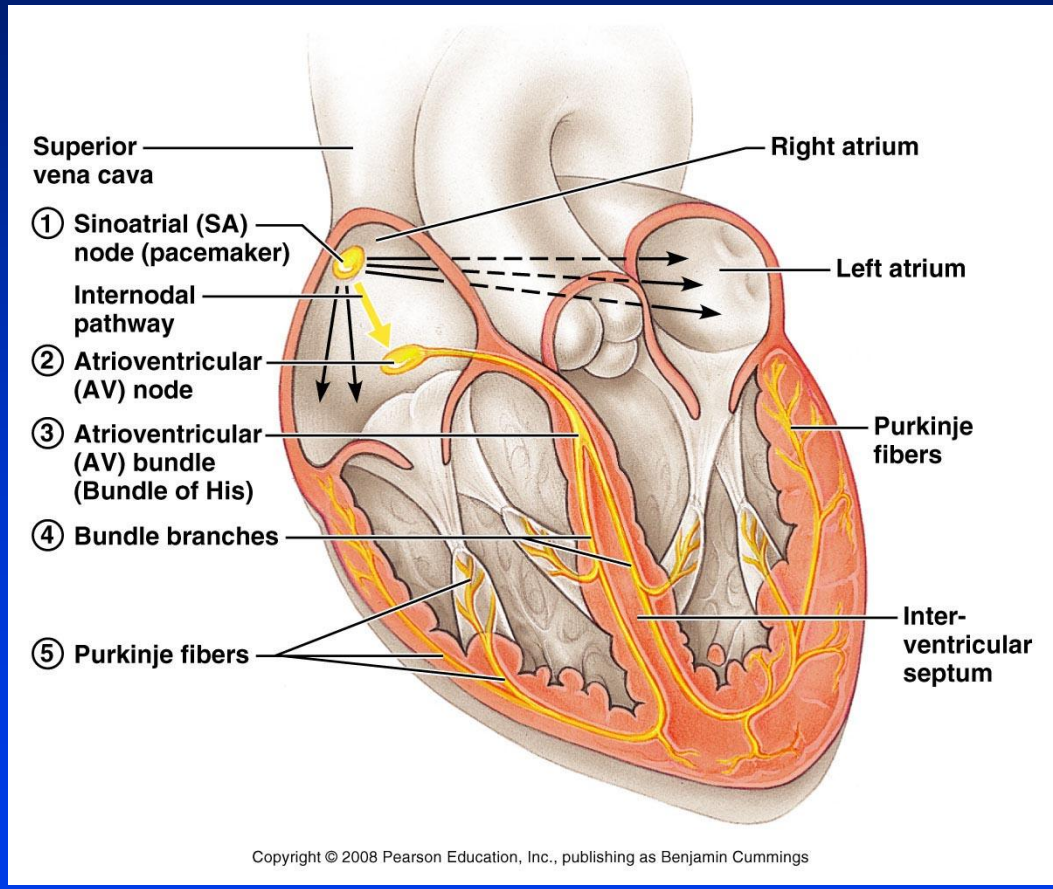
The EKG

- P-wave
  - Depolarization of atria
- Delay at A-V node
- QRS complex
  - Depolarization of ventricles
- T-wave
  - Repolarization of ventricles



EKG rhythm strip



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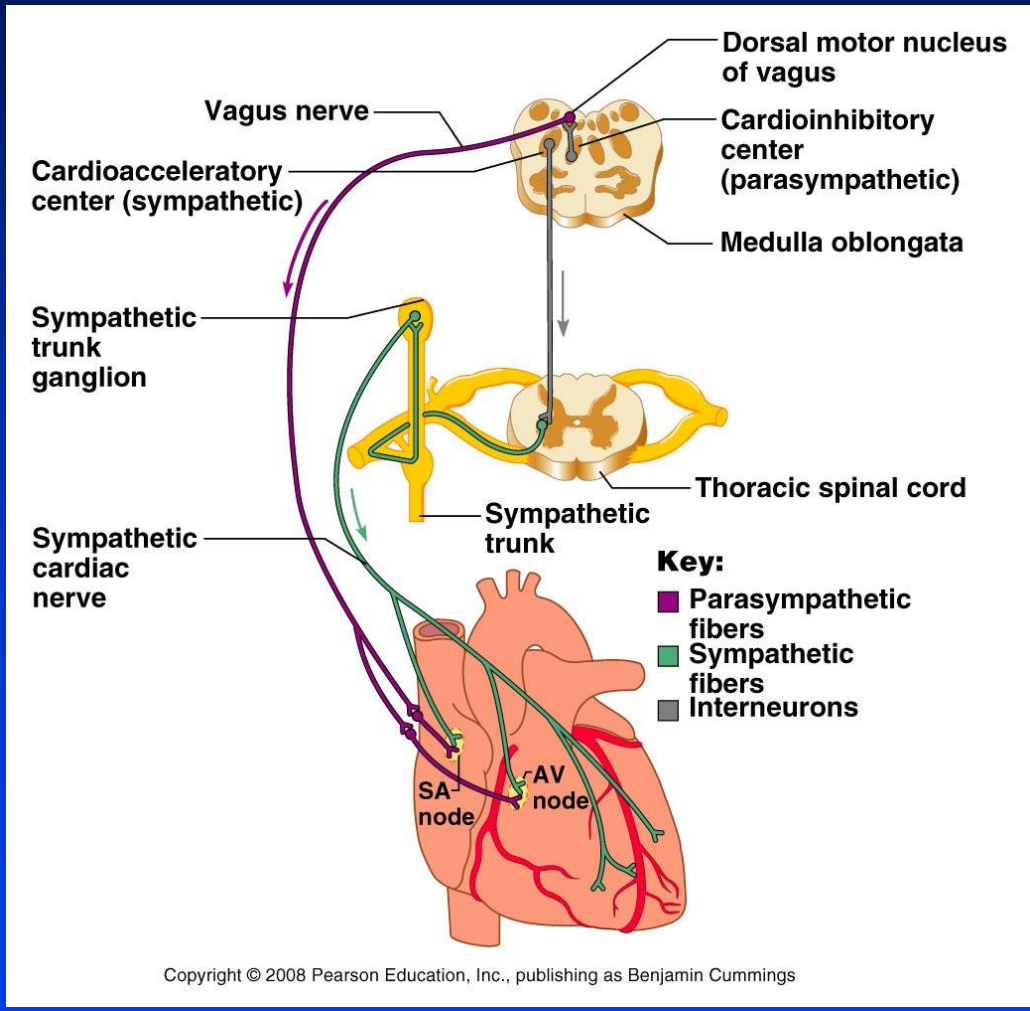
Autonomic Innervation of the Heart

- Parasympathetic
  - Vagus nerve (CN X)
- Sympathetic
  - Via sympathetic trunk



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